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A Comparative History of Resurrection Plants

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Volume 19 Issue 2 (June 2019) Article 1

John Charles Ryan,

"A Comparative History of Resurrection Plants"

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Abstract: In his article "A Comparative Literary History of Resurrection Plants" John Charles Ryan assembles a comparative history of resurrection plants through textual analysis of early botanical commentaries, herbal references, prose, poetry, and other sources. Resurrection plants include a diverse range of botanical species, typically of arid regions, that appear to come back to life after complete desiccation. Historical and contemporary observers—from sixteenth-century herbalist John Gerard to contemporary Australian poet John Kinsella—have expressed an abiding fascination for resurrection plants' capacity to survive harsh environmental conditions. The plants court their own deaths by paring down—then restoring—physiological processes in relation to shifting ecological circumstances. While researchers over the years have attempted to reveal the mechanisms involved, the uncanny adaptations of resurrection plants remain a wonder and source of inspiration for scientists, humanists, and artists alike. Drawing from recent concepts in the field of "critical plant studies," this article concludes by asserting that listening to the lessons of plants is essential to reimagining an ethical and sustainable future. In the present era of rapid species loss worldwide, resurrection plants offer messages of hope and renewal to societies struggling to devise ways to live sustainably with the biosphere.

John Charles RYAN**A Comparative Literary History of Resurrection Plants**

The term *resurrection plant* denotes a diverse range of about one-hundred-and-thirty plant species—normally endemic to arid areas of the world—that appear to return to life after drying out, withering, and turning brown as an adaptive response to drought. All resurrection plants known to science are angiosperms (flowering plants) belonging principally to three botanical families: Gesneriaceae (la-miale), Myrothamnaceae (myrothamnus), and Scrophulariaceae (figworts) (Phillips, Oliver, and Bartels, "Molecular Genetics" 320). Many species of this grouping inhabit rock outcrops at low to moderate elevations in southern Africa, Australia, India, and parts of South America and Central America, although other species are epiphytes growing on host trees. In a seminal scientific account, typically referenced in resurrection plant studies of the past forty years, Gaff observed the distinct abundance of flowering plants in the South African flora that withstand full desiccation ("Desiccation-Tolerant" 1033–34). Within their habitats, resurrection plants successfully exploit ecological niches with limited seasonal water availability, where other species cannot survive. Exhibiting an unusual capacity to tolerate extreme waterlessness, they return from an air-dried state of metabolic arrest once favorable hydrological, seasonal, or climatic conditions resume.

The water content of the foliage of resurrection plants corresponds to variations in the relative humidity (RH) of the local environment (Gaff, "Desiccation-Tolerant" 1033–34). This "hygroscopic" characteristic causes the leaves to curl up and shrivel when dry, for extended periods of time, then unfold and turn green when moist. Botanists tend to define resurrection plants as "a small group of poikilohydrous higher plants which tolerate almost complete water loss in their vegetative tissues and resume normal functional activity after rehydration: occur in specific ecological niches with seasonal water availability" (Black and Pritchard, "Glossary" 380). The use of the descriptor "poikilohydrous" points to the hygroscopic nature of resurrection species in which their internal water content fluctuates according to air moisture changes, causing the suspension of metabolism during drought conditions in order to persist where other botanical taxa would perish (Black and Pritchard, "Glossary" 380). In accordance with their apparent dying and coming back to life, resurrection species have developed numerous specific physiological strategies, for instance, to offset the mechanical damage caused by a drop in internal water pressure as part of their poikilohydrous nature (Phillips, Oliver, and Bartels, "Molecular Genetics" 320). There are also those species that lose chlorophyll (the photosynthetic pigment found in plants) during dehydration compared to those that retain their chlorophyll—adaptive differences used by botanists to distinguish between categories of resurrection plants.

Researchers argue that global climate change, increasingly unpredictable weather, and a growing worldwide population present significant obstacles to the sustainability of agricultural production in the future (Williams, Njaci, Moghaddam, Long, Dickman, Zhang, and Mundree, "Trehalose Accumulation" 1 <<http://dx.doi.org/10.1371/journal.pgen.1005705>>). Hastened in their efforts by the variable effects of climate change and acute water shortages globally, scientists have turned more attention to revealing the desiccation tolerance (DT) strategies employed by resurrection plants (Farrant and Moore, "Programming Desiccation-Tolerance" 340–45 <<http://dx.doi.org/10.1016/j.pbi.2011.03.018>>). DT is defined as the capacity to endure vegetative tissue drying to the near total loss (eighty- to ninety-five percent) of moisture content (Pampurova and Van Dijck, "The Desiccation" 285). Enhanced knowledge of DT mechanisms is expected to contribute to the formulation of new agricultural crop varieties incorporating the adaptive physiological processes of resurrection plants and thus becoming more resilient and productive in the face of climate change-exacerbated weather variability. For instance, Williams, Njaci, Moghaddam, Long, Dickman, Zhang, and Mundree studied the characteristics of the resurrection species *Tripogon loliiformis* (a grass genetically related to cereals, rice, sorghum, and maize), explicating the plant's unique ability to expel cellular toxins, manage programmed cell death, and recycle nutrients to postpone the beginning of senescence ("Trehalose Accumulation" 1–17). *T. loliiformis* also was shown to control its sugar metabolism to enhance desiccation tolerance (DT) and could furnish genes of promise for use in developing stress-resistant crops.

In conjunction with their strong agricultural, ecological, and scientific value, resurrection plants have played a small but noteworthy role in the art, culture, literature, and botanical histories of various traditions across time and in diverse parts of the world. As an example, the seventeenth-century English poet Robert Herrick in his poem "To the Duke of York" opens with the metaphor "May his pretty Duke-ship grow / Like to a rose of Jericho, / Sweeter far than ever yet / Showers or sunshine could beget" (lines 1–4 <<http://www.bartleby.com/337/392.html>>). Through textual analysis of early scientific commentaries, herbal sources, and prose, and with an emphasis on poetic works, this article

offers an initial attempt to compile a comparative literary history of resurrection plants. While these species have been investigated by scientists for their exceptional evolutionary mechanisms and as potential genetic sources for formulating drought-tolerant crop varieties, resurrection plants have not figured comparably into recent studies of the interconnections between cultural production, creativity, and botanical life. An emerging interdisciplinary trend in studies of the cultural histories of charismatic plant groups—forwarded most notably by a monograph series entitled "Botanical," published since 2013 by Reaktion Books—has included the botanically themed and attentive histories *Bamboo* (Lucas), *Cannabis* (Duvall), *Grasses* (Harris), *Poppy* (Lack), and *Snowdrop* (Harland), among several other titles. Harland, for instance, investigates snowdrops as symbols of purity, hope, and consolation, as evident in paintings, poetry, and prose principally from Victorian era Britain. Similarly, Harris examines the ecocultural importance of grasses through a combination of biology, sociology, and cultural history, including literary sources as references.

The central issue addressed and scholarly lacuna filled by this article center around the absence of comparable literary studies attending to resurrection plants: a grouping of charismatic botanical taxa that have mesmerized and inspired writers for centuries—including in the present era—with their collective ability to seemingly perish then come back to life. For most historical observers and commentators, resurrection plants were unusual for their ability to court their deaths by paring down—then restoring—metabolic processes in correlation to shifting ecological circumstances. Considering the wide spectrum of taxa classified as resurrection plants, the discussion focuses mainly on the literary histories of four species in particular: rose of Jericho (*Anastatica hierochuntica*), resurrection moss (*Selaginella lepidophylla*), resurrection fern (*Pleopeltis polypodioides*), and pincushion lily (*Borhya nitida*). To begin with, plants of the genus *Anastatica* (derived from the Greek word *anastasis* for *resurrection*) grow in the arid environments of the Middle East and the Sahara Desert, geographically spanning North Africa, Iran, Egypt, Palestine, Israel, Syria, Jordan, and Pakistan. The rose of Jericho (*A. hierochuntica*) is widely distributed in the Sahara-Arabian desert areas where whole specimens are used for treating fatigue and uterine hemorrhage in Egyptian folk healing (Nakashima, Matsuda, Oda, Nakamura, Xu, and Yoshikawa, "Melanogenesis Inhibitors" 2337).

The second species addressed here is native to the Chihuahuan Desert of the United States and Mexico. The resurrection moss (*S. lepidophylla*, also known as bird's nest moss) returns to a green appearance approximately twenty-four hours after rehydration when photosynthesis and respiration recommence normal levels (Pampurova and Van Dijck, "The Desiccation Tolerant Secrets" 285). In a dry state, the plant is frequently sold as a novelty item and, in some Mexican markets, as a diuretic (an herbal medicine facilitating the passage of urine) (Dimmitt, "Plant Ecology" 138–39). As the third example, the resurrection fern (*P. polypodioides*, also known by the common names little gray polypod, scaly polypody, and miracle fern) is a widespread epiphytic fern occurring in South America, Mexico, the southern United States, the Caribbean, and Africa. An early study by Louis Pessin (1925) of the fern growing in the north-eastern part of Mississippi, documented the species' occurrence on a diverse range of host trees especially oaks ("An Ecological Study" 17–38). As the final example to be examined, endemic to Western Australia, the pincushion lily (*B. nitida*) inhabits rock outcrops and withstands dehydration to below five percent of its normal leaf moisture content, indicated by the orange color of the leaves that revert to green within twenty-four hours of receiving rain (Hetherington and Smillie, "Tolerance" 76–81).

The comparative literary history of resurrection plants was organized around these five species and the main common names associated with them. In particular, the analysis considered the concept of "resurrection" as it relates to these distinctive botanical taxa and some of their literary representations through history. Appearing in English in the 1300s, the noun "resurrection" derives from the Anglo-French term *resurrectiun*, the Old French *resurrection* (specifically denoting the Resurrection of Christ), and the Latin *resurrectionem* for "a rising again from the dead" and *resurgere* for "rise again, appear again" (Harper, *Online Etymology Dictionary* <<http://www.etymonline.com/index.php?term=resurrection>>). In the 1640s, the sense of resurrection as a revival came into common parlance in English. Apart from the strong Christian overtones of the term, "resurrection" also implies a more generalized sense of someone or something—actually or metaphorically—returning from a state of near-death, obsolescence, or senescence. As a noun, "resurrection" involves a defying of the odds of death; as a participial verb, "resurrecting" evokes the course of being brought back to life from a brush with mortality. In assembling an abbreviated critical overview, this article asks: What might it mean, then, for other-than-human life—a plant or animal, for instance—to resurrect itself? Additionally, what are the symbolic implications of resurrection in the vegetal world as depicted in literary works through history? Finally, how might societies today—confronted with the challenges of the Anthropocene and unbridled species loss—benefit from the inspiration and practical guidance afforded by resur-

rection plants?

In *The Philosopher's Plant*, Michael Marder forwards some possible responses to these questions—or, at least, potential ways to approach such queries. Marder quotes the early nineteenth-century German philosopher Georg Wilhelm Friedrich Hegel, reflecting melancholically on dry flowers kept as a *memento mori* of his friend: "The flowers are of course dry and life has vanished from them. But what on earth is a living thing if the spirit of man does not breathe life into it?" (quoted in Marder, *The Philosopher's Plant* xvii). In Hegel's view, the divine spirit suffusing human beings grants new existence or resonance to the dead things of nature, epitomized by the desiccated flowers. In directly channeling spiritual animus—as beings privileged by God, but also self-valorizing—humans hold the power to resurrect vegetal life actually or figuratively. In this quoted passage, Hegel appears to negate resurrection—of being revived or brought back to life—as a potentiality of inner provenance to other-than-human life.

Notwithstanding Hegel's provocation, resurrection plants exemplify the capacity of some members of the botanical kingdom and the things of nature to return from the brink of decline and near-death through energies internal to them and in harmonization with the exigencies of their environments. Through the materiality of their adaptive ecologies, resurrection plants refute Hegel's anthropocentric assertion that a living thing has potential only if human spirit goads animus back into it. Resurrection plants hold vast potential for supporting humanity by resurrecting our values, beliefs, configurations, and conventions from the death knell of late capitalism and the totalizing pallor of globalization. Accordingly, Marder (*Plant-Thinking*) defines the titular concept of his book as a mode of being with plants of all kinds—of learning from the wisdom of botanical life and recasting social structures to mimic the adaptive successes of flora, such as resurrection plants. He also recognizes that, in some non-Western spiritualities, human souls are considered to reincarnate in plants, thus firmly linking the idea of resurrection to the vegetal world (Marder, *Plant-Thinking* 67).

The four species of resurrection plants—*Anastatica hierochuntica*, *Selaginella lepidophylla*, *Pleopeltis polypodioides*, and *Borya nitida*—served as the basis for identifying suitable historical and literary sources. Both the scientific (genus and species) and common names were used in locating textual material that depicts resurrection species as well as literary items in which the plants provide symbolic or narrative functions. Digital databases—for instance, the Biodiversity Heritage Library (BHL)—were checked exhaustively using the scientific and common names of the plants as search terms. The process aimed to identify material spanning four historical and literary categories: early botanical commentaries, herbal sources, prose, and poetry. The first category—botanical commentaries—comprises the writings of early plant scientists, naturalists, or explorers who observed resurrection plants either in cultivated or natural settings. This category includes technical material, such as taxonomic treatises, aimed at classifying newly discovered resurrection species. It also includes written narratives recounting field excursions during which taxa were described, illustrated, collected, and dried, and then transported to botanical gardens, conservatories, or research centers located near metropolitan areas in Europe or North America.

The second category of content—herbal sources—refers to texts composed by herbalists or practitioners of folk medicine, such as John Gerard, detailing the therapeutic applications of resurrection plants. The third—prose—encompasses novels, short stories, essays, and forms of creative nonfiction that in some manner engage resurrection plants as subjects, symbols, or catalysts of the writing. The final—poetry—covers verse composed in reference, or alluding, to resurrection species. Where possible, in light of the biogeographical contexts of the works or backgrounds of their writers, the scientific names of the flora described in the historical and literary material were noted. The archival, text-based approach put into practice sought to elicit items for synthesizing a literary history of resurrection plants, albeit a history that is incomplete and would benefit from subsequent research. According to cultural theorist Alan McKee, "when we perform textual analysis on a text, we make an educated guess at some of the most likely interpretations that might be made of that text" (*Textual Analysis* 1). For cultural studies scholars, the term "text" broadly signifies literary works (poetry and prose, fiction and non-fiction) plus "films, television programmes, magazines, advertisements, clothes, graffiti, and so on" (McKee, *Textual Analysis* 1). Textual analysis was conducted in conjunction with ecocritical theory as a lens for understanding works as "environmental texts," those which represent ecological issues or the environment, particularly plant life and botanical habitats (Buell, *The Environmental Imagination*, 6-8). Focused on combining archival research and textual analysis, the approach can be characterized as "resurrecting"—defined, in this context, as evaluating (and, indeed, bringing life back to) archival material and lesser known literary figures by foregrounding the plant-based subject matter of the texts and the botanical sensitivities of the writers.

The approach pivots most generally around ecocriticism—an interdisciplinary field defined over

twenty years ago by literary scholar Cheryl Glotfelty as "the study of the relationship between literature and the physical environment [which takes] an earth-centered approach to literary studies" (quoted in Garrard, *Ecocriticism* 3). Ecocritical studies focus on the environmental dimensions of texts, broadly conceptualized in McKee's sense to comprise literary works, cinema, performance, digital media, and artifacts of popular culture. Through dialogue between scientific, ecological, and humanistic concepts, ecocriticism gives prominence to other-than-human protagonists and subjects. An emerging concentration within ecocriticism is "critical plant studies," an area of inquiry that "seeks to redress the long-standing biases that have proscribed plants from the spheres of intelligence, agency, and ethics" (Vieira, Gagliano, and Ryan, "Introduction" x). Research in critical plant studies emphasizes the abilities of plants to adapt, sense, learn, and behave in dynamic relation to their environments. The ecocritical subfield recognizes that, in addition to furnishing food, medicine, fiber, decoration, and spiritual objects to humans, plants also influence creative production and literary form.

The multidisciplinary focus—synthesizing botanical and literary studies—makes possible a closer analysis of the intersection between storytelling and the natural world that is a salient feature of literary works depicting resurrection plants. The linkages between storytelling (an activity normally associated with the creative arts and humanities) and botanical knowledge (a system of empirical understandings of plants, usually positioned within the natural sciences) comprise an essential component of this approach. Narratives embody a particular structure based on cause-and-effect relationships between events and characters over time and positioned in a setting, location, or place (Dahlstrom, "Using Narratives" 13614). Often regarded negatively as anecdotes based on generalizations from a small population or limited set of samples, narratives tend to be held in sharp contrast to the logos-driven, objectively-oriented, context-independent style of communication privileged within the sciences. Notwithstanding their empirical limitations, narrative techniques—for example, the use of metaphor to foster empathy and stimulate the imagination—hold the potential to impart a much-needed human scale to exceptionally distant and abstract scientific themes (Dahlstrom, "Using Narratives" 13618), especially those concerning the future of the natural environment and issues of sustainability.

In his *The Herball, or, Generall Historie of Plantes*, originally published in 1597, the pre-Linnaean botanist and herbalist John Gerard referred to *Anastatica hierochuntica* as the "heath rose of Jericho," categorizing it as a heath rather than a mustard or cabbage (family Cruciferae). Gerard probably grew a specimen in his extensive gardens. Like subsequent commentators, he noted the contradiction of the vernacular name, rose, exclaiming with a sardonic tenor that "the coiner spoiled the name in the mint, for of all plants that have been written of, there is not any more unlike a Rose, or any kind thereof, than this plant" (*The Herball* 1386). Gerard imaginatively noted the physical structure of *A. hierochuntica* "intricately weaving itself one stick upon another, like a little net: upon which woody sticks do grow leaves not unlike those of the Olive tree, which makes the whole plant of a round form, and hollow within" (*The Herball* 1386). Half an hour after being exposed to water or moisture, the species "opens itself in form, as when it did grow, and takes forth until it dries, returning shut again as before" (*The Herball* 1387). Despite the relative accuracy of this early written account, Gerard—both a botanist and herbalist—surprisingly failed to indicate any of the therapeutic properties attributed by subsequent commentators to the rose of Jericho.

The Scottish geographer Hugh Murray (1779-1846) furnished an early nineteenth-century account of the rose of Jericho in his colossal *Encyclopædia of Geography* (originally published in London in 1834), presumably with technical assistance from the famed English botanist William Jackson Hooker who is credited on the book's cover. In Chapter 2 of Book II, which details the natural geography of Turkey, Murray writes that "the plant, vulgarly known under the name of the Rose of Jericho, is no rose at all, but a small cruciferous plant, a native of the deserts of Arabia, the *Anastatica hierochuntica* [no italics in original]" (Murray, *The Encyclopædia* 243). In a declarative manner, Murray marks his account of the species by debunking its common (vulgar) name. Rather than a bonafide rose, *A. hierochuntica* is a member of the Brassicaceae (or Cruciferae) botanical family and a relative of common mustards and field cabbages. In particular, the excerpt from *Encyclopædia of Geography* crystallizes the tension between common and scientific practices of naming plants. The systematization of botanical naming was spurred by taxonomist Carl Linnaeus in the eighteenth century who devised a convention of binomial denominations, composed of genus and species, as a universal means for faithfully rendering the identities of botanical taxa (Dickinson, *Carl Linnaeus* 1-24).

After the geographer's statement of nomenclatural fidelity, the passage characterizes the peculiar wind-driven desiccation of *A. hierochuntica* in which the thorny branches dry out and contract to "form a kind of round tuft, about the size of a man's fist" (Murray, *The Encyclopædia* 243). Vaguely implicating the commonplace fallacies and unscientific notions surrounding the rose of Jericho at the time, the geographer comments, with reserved disdain, that "the most ridiculous fables were invented respect-

ing this plant, at a period when superstition greedily received them" (Murray, *The Encyclopædia* 243). The geographer refrains from discussing any specifics about the fables—the task, in all probability, better left to folklorists, herbalists, and popular commentators. He and his colleagues, however, reflect an Enlightenment ethos that privileges scientific discourse as the principal means for illuminating the supposed falsehoods plaguing the plant knowledge of common people. Rather than an unexplainable miracle or supernatural occurrence, *A. hierochuntica* exhibits an intrinsically poikilohydrous constitution: "...it is undoubted and remarkable fact, that the Rose of Jericho opens and extends its branches when immersed in water, or when the atmosphere is very damp, and resumes its former appearance when exposed to the wind or to heat" (Murray, *The Encyclopædia* 243).

The Penny Cyclopaedia (1839) published by the Society for the Diffusion of Useful Knowledge (SDUK), a Whiggish London organization that published popular accounts of scientific information, gives the following botanically informed appraisal of the rose of Jericho: "...their hygrometrical properties cause them to unfold, and to assume something the appearance of a rose" (*The Penny Cyclopaedia* 105). In the use of technical idiom "hygrometrical," the writer denotes the hygroscopic, poikilohydrous, humidity-dependent characteristic of the plant that underlies its processes of metabolic arrest, drying, and reviving. Unlike the imaginatively-restrained Murray, the writer elaborates on the significant religious ideas surrounding the rose of Jericho: "...the people of the East have attached the fable that the plant first blossomed at the moment when our Saviour was born" (*The Penny Cyclopaedia* 105). As such, the resurrection of *A. hierochuntica* is linked symbolically to the divine birth of Christ, who would also defy his crucifixion and, in doing so, grant eternal salvation to his followers. Furthermore, *A. hierochuntica* as representative of the Savior extends broadly as a folk symbol of the progression of female labor and parturition: "...if put into water when labour commences, it will indicate by its expansion the progress of parturition, and will finally expand when the child is born" (*The Penny Cyclopaedia* 105). Thus, another name for the rose of Jericho is Saint Mary's flower, for the holy mother of God (*The Penny Cyclopaedia* 105).

The nineteenth-century English poet Christina Georgina Rossetti (1830-94) enshrined *A. hierochuntica* in her poem "A Rose Plant in Jericho," initially published in 1875. The poem is ostensibly a lyrical exegesis on resurrection, on mortality and immortality, on dying and returning to life—symbolic themes manifest materially in the ecology and physiology of the plant itself. As Simon Humphries observes, the title of Rossetti's poem alludes to the Book of Ecclesiasticus chapter 24, verse 14: "I was exalted like a palm tree in En-gaddi, and as a rose plant in Jericho, as a fair olive tree in a pleasant field, and grew up as a plane tree by the water" (*King James Bible Online* <<http://www.kingjamesbibleonline.org/Ecclesiasticus-24-14/>>). Humphries argues that the poem's title bears no relation to *A. hierochuntica*, which he emphasizes is not a rose ("Notes" 460). In contrast to this view, it could be asserted that Rossetti delicately evokes the biblical connotations of *A. hierochuntica* as a resurrection species in order to poeticize themes of life and death, fragmentation, and wholeness. Considering the rise of popular accounts in nineteenth-century British culture of the Sahara-Arabian species, as exemplified by *The Penny Cyclopaedia* (1839), *A. hierochuntica* would have been reasonably familiar to a large segment of British society. Rossetti's "rose with scarce a thorn" that "drooped, and all its gay increase / Was but one thorn that wounded me" (*Christina Rossetti* 214, lines 3, 6–7) could be a subtle reference to the rose of Jericho as, indeed, a far more effective metaphor for mortality and potentiality than the common rose and its unambiguous and hackneyed thorniness. Like the rose of Jericho awaiting in a state of metabolic arrest for its resurrection as the first rains come, Rossetti's forbearance involves an anticipation of increase: "For verily I think to-morrow morn / Shall bring me Paradise, my gift's increase, / Yea, give Thy very Self to me" (*Christina Rossetti* 214, lines 16–18).

The common name "resurrection plant" has been applied broadly to over one-hundred-and-thirty species of flora—of diverse taxonomic origins—having the ability to desiccate with drought conditions, resuming an ordinary state as hydration returns. In the absence of the mention of a Latinate name, the identity of a species depicted by a writer can remain ambiguous. Like many taxa in this grouping, the resurrection moss (*S. lepidophylla*), native to the Chihuahuan Desert of the United States and Mexico, has been generically represented by writers through time, unconcerned with taxonomics, as a resurrection plant. However, geographical descriptors attached to vernacular names in tandem with knowledge of where certain writers lived and wrote can point to the more precise identity of the plant in question.

These considerations hold true in relation to a brief posting in the publication *The Latter-day Saints' Millennial Star* from 1868, providing a descriptive account of a "so-called Mexican Resurrection Plant ...exhibited and sold in New York" (Carrington, *The Latter-day* 799). Characterized as a native of southern Mexico, the species in focus is most likely a variety of *S. lepidophylla*, or the resurrection moss. The passage relates how "the plant is apparently dead, but it requires only water to unfold be-

fore the eyes with rich leaves of an emerald hue" (Carrington, *The Latter-day* 799). To be sure, the "emerald hue" of the resurrected specimen is more in keeping with a club moss than any member of the cabbage plant family, such as *A. hierochuntica*. The specimen's poikilohydrous character is an identifiable feature: "...during the rainy reason, it flourishes luxuriantly, but in the dry weather dries and curls up, and is blown about by the wind. Every such specimen, however, when placed in a plate of water, burst into new life" (Carrington, *The Latter-day* 799). According to the extract from the *Mil-lennial Star*, the resurrection moss is, therefore, also an iconic tumbleweed of the deserts of Mexico and the western United States.

The Alabama-born writer Mollie Moore (1844-1909) composed a poem in rhyming quatrains titled "The Resurrection Plant," the subject of which is most likely the resurrection moss, *S. lepidophylla* inhabiting the southern United States as a tumbleweed. In 1955, Moore's family moved to a farm in rural Texas where the adolescent poet would surely have encountered tumbleweeds especially during the arid summers. One of the most commercially successful professional writers in the southern American region at the turn of the twentieth century, Moore wrote in numerous genres, including as a poet, short story writer, novelist, playwright, and memoirist (Wilkinson, *The Broadening Stream* 1). The poem opens with a rather pejorative evocation of the resurrection moss as an invasive, unwelcomed, unsightly blow in: "The useless thing was cast aside, / A mesh of black and withered roots; / It came among some clods of earth / That clung among those foreign fruits" (Moore, *Poems* 166, lines 1-4). Moore's poetic depiction confirms the resurrection specimen's desiccated summer condition. Yet, the third quatrain marks a change in voice as it relates the image of a girl—presumably the young poet herself—spreading the feminized, dried tumbleweed in a "crystal dish" and pouring "pure water on its breast" (Moore, *Poems* 166, lines 6-7).

No longer merely a useless drifting thing, as the tumbleweed's "emerald heart" blazed with the water, the specimen turned into "the fairest thing in all the land" (Moore, *Poems* 166, lines 15-6). Mid-way through the poem, Moore encapsulates the marvel of beholding the resurrection moss undergo a kind of divine transformation—with the aid of a holy offering of water—from a forlorn state of desiccation and drifting across the pastoral Texas landscape to one of luxuriance, vibrancy, indigenization, and indeed rootedness in the beauty of the garden, "where the blossoms bloomed" (Moore, *Poems* 166, line 11). Following this pivot point in the composition, the second half, consisting of four quatrains, diverts from the material evocation of the resurrection moss in time and space to abstract Christian themes. The plant is rendered a poetic symbol of God's forbearance for human foibles, his patience with unrealized spiritual potential sullied by "the last dregs of the cup" (Moore, *Poems* 166, line 24) rather than the pure redeeming essence of "healing drops" (line 30). The intervention of God animates "that poor, unsightly thing" (line 29), the failing human represented by the desiccated, alienated tumbleweed of the poem's opening.

The poem's second half echoes Hegel's notion—quoted by Marder in *The Philosopher's Plant*—of human spirit as a matrix for the divine animating the things of nature, of God effectively "resuscitating" dried flowers, impregnating them with metaphysical potential, with redeeming breath. Moore figures the young girl with the "crystal dish" as a conduit for the Creator who intervenes with sacred drops of water, bringing the despicable "mesh of black and withered roots" (Moore, *Poems* 166, line 2) back to life in the originary garden of the creator and his followers. Despite its promising ecological dimensions early on, Moore's poem ultimately represents a negation of the power of vegetal nature for self-transformation, autopoiesis, and finely-tuned synchronization with the larger habitat of which it is part.

Moore's ambivalent attitude toward the agency of the resurrection moss coalesces divergent senses of initial revulsion and sanctimoniousness with ensuing awe and respect in correspondence to a realization of the plant's divine value. Such an interpretation belies the rich medicinal tradition of *S. lepidophylla* as an herbal substance used directly as an agent in folk healing systems. Locally termed *doradilla*, resurrection moss was known to be used to treat syphilis among the inhabitants of Monterrey, Mexico, according to the observations of nineteenth-century French-Mexican naturalist Jean Louis Berlandier (Lawson, *Frontier Naturalist* 169). Tea made from *doradilla* fronds is still employed in Mexican folk medicine, and is sold in markets for healing ailments of the kidneys and liver, including bile stones and conditions requiring diuretics (Ugent, "Medicine, Myths" 435). Used to treat obesity, *doradilla* contains a range of common acids and minerals that provide electrolytes in support of kidney functioning. Ethnobotanists have suggested further research into the potential applications of the resurrection moss in kidney, liver, and digestive disorders (Winkelman, "Frequently" 122). As these studies indicate, the "useless thing"—in Moore's terms—proves not only to resurrect itself from the brink of metabolic arrest but to also breathe life back into human beings suffering from a variety of physical ailments. Thus, the resurrection moss is far greater than a living trope for human mortality and spiritual

revival—or a curious novelty exchanged in marketplaces. Instead the species is a direct supplier of sustenance, health, and wellbeing, as its rich herbal profile indicates.

Common in parts of South America, Mexico, the southern United States, the Caribbean, and Africa, resurrection ferns have also been the subjects of historical description and literary portrayal. As for the resurrection moss and other species, it is intriguing to consider the medicinal properties of these polypods in conjunction with their historical and literary renderings. In the language of the Lumbee Indians of North Carolina, the resurrection fern is known as "tapasi moso here," or "plant that grows on a rough branch" (Boughman and Oxendine, *Herbal Remedies* 69). The Lumbee traditionally submerged the roots, stems, and leaves in water, boiling the plant material until only a small amount of liquid remained. The boiled-down liquid was then combined with tallow or another alternative to create a salve for assuaging external wounds. Some nineteenth-century herbalists believed that the resurrection fern drained away the vitality of its host trees, particularly oaks, while other commentators asserted that carrying the fern would cause someone to turn invisible (Boughman and Oxendine, *Herbal Remedies* 69). Traces of folk beliefs alongside naturalistic observations of the plant in its habitat figure into some of the poetry of *P. polypodioides*.

Contemporary American poet Mary Romero's "Resurrection Fern" opens with what appears to be an historical epigraph from an unnamed source providing an accurate physiological evaluation of the plant. The epigraph concludes with a blatant exaggeration, underscoring the inimitable position of these taxa within the public imagination: "...this fern survives by curling its fronds and appearing grey-brown and desiccated. However, when just a little water is present, the fern will reopen. It has been estimated that these plants could go 100 years without water and still revive" (quoted in Romero, "Resurrection Fern" 76). Reminiscent of Moore's poem "The Resurrection Plant" written more than one-hundred years earlier (but lacking Moore's prominent religious metaphorization), Romero's verse foregrounds the ubiquity of the species within her bioregion and its imbrications with the memories of the poet: "All my childhood it was there / and I never saw it because / I never knew its name, / didn't understand what / death meant" ("Resurrection Fern" 76, lines 1-5).

Now set within the poet's consciousness through its bearing a name, the resurrection fern emblemizes gracefulness in the face of the inevitability of death, its "dead coils of brown / snake so close to the bark / that it seems to be the live oak" ("Resurrection Fern" 76, lines 8-10). As an epiphytic species, the fern merges with the body of its host tree. The plant's sacred ecology of life within death is self-animating, eschewing reduction to human terms and appropriation for spiritual purposes. Rather than breathed into life by a divine orchestrator, or made to come alive through an ascription of meaning, the resurrection fern is autopoietic and self-governing—a singularity within an ecological plurality—exhibiting the sensitivity of intelligent beings. The plant "feeds on air, like angels, / drinks in its burial by rain and dew, / and after merely hours / in a thirsty morning, / rolls back in greenness / deeper than the light can show" ("Resurrection Fern" 76, lines 22-7). Romero's evocation of the fern centers on the alignment of the naming of plants with human memory and perception. A plant name—especially one containing such a metaphysically-charged term as "resurrection"—catalyzes awareness and activates movements of recollection and interconnection.

Contemporary American poet Laura Sobott Ross's "He Brings Me Resurrection Ferns" (2012) portrays the plant as an emblem of enduring love, as an epiphytic alternative to roses, daisies, pansies, and more widely familiar signs of affection between humans. The resurrection ferns, gifted to the poet, "go brown with introspection" ("He Brings Me" line 8) after being "unstitched from hundred-year-old / live oaks" (lines 11-2)—an allusion to the adaptive hygroscopic ecology of the species. Ross's poem departs from others—Moore's peripatetic tumbleweed, for instance—in its ecological subtext and suggestion of an ethics of care. In being salvaged from a soon-to-be razed lot, the resurrection ferns themselves were rescued through human intervention. Unlike Hegel's dried flowers memorializing his friend, the salvaged plants—life, of course, being "vanished from them"—bear a kind of agency independent of the spirit of humans breathing life back into them. In this manner, Ross' verse intimates a relationship of reciprocity between plants and people in which the fern confers emotional meaning and the human protagonists grant another chance at "living" to the plant. By the poem's conclusion, Ross reflects on the mysteriousness of the fern's mode of being: "What makes a living thing mutate its genes / so it could appear dead for a hundred years / and revive after a single soaking?" ("He Brings Me" lines 16-8). Rather than *memento moris*, the epiphytic ferns are "rootless remembrances / that live off sun and air" ("He Brings Me" lines 23-24).

Borya nitida describes about six different kinds of pincushion lilies endemic to the biodiverse southwest corner of Western Australia. These low-growing prostrate plants occupy very different habitats to the three species discussed so far: coastal granite outcrops and offshore islands (Nikulinsky and Hopper, *Life on the Rocks* 76). Australian writer and critic John Kinsella's poem "Resurrection Plants at

Nookaminnie Rock" (*Armour* 53) presents an interpretation of death in the botanical kingdom and the potential for life by narrativizing the resilient mechanisms of the pincushion lily. Like other resurrection plants, it is known for its ability to endure episodes of dehydration through metabolic arrest (Nikulinsky and Hopper, *Life on the Rocks* 24). Sequestered at Nookaminnie, a boulder enclave near Quairading in the wheatbelt region of Western Australia, the *Borya* defy, through their physiological adaptations, the "belief that the dead will stay dead / and there will be no lift, no rebirth" (Kinsella, *Armour* 53, lines 11–2). What emerges in the middle of the poet's biogeographically-articulated contemplation of life, senescence, birth, and regeneration in the botanical world is an ethics of plants, revolving around intimate ecological knowledge, profound regard for endemic flora, and a recognition of the limits of proximate human-plant encounters. One must always tread conscientiously in fragile rock outcrop environments, stepping "carefully around these / wreaths hooked into granite sheen, holdalls / for a soil-less ecology" (Kinsella, *Armour* 53, lines 14–6).

The pincushion speaks to the poet—and speaks of the courting of death and the return from its brink—via a haptic, material presence, at once soft and bristly. Nevertheless, the plant "would say so much more if your boots / were off" (Kinsella, *Armour* 53, lines 17–8)—if physical exchange could be consummated. Undergirded by sensitivity toward the granite outcrop habitats of the species, the poet's ethics of stewardship come to restrain his impulse to sink more deeply into the inevitable mystery of co-constituted human-plant lives and deaths. In its defiant brinkmanship, the resurrection plant exemplifies the assertion that the event of death does not necessarily spell out the end of a plant's existence (Marder, *The Philosopher's Plant* 187). "Resurrection Plants" textualizes vegetal death and near-death, principally, as a process of embodied, ecological marvel and, secondly, as suggestive of the possibility of ecosystemic renewal and social hope through respectful, reciprocal engagements with the vegetal inhabitants of one's place.

Widely distributed across the globe, resurrection plants are known for their unusual capacity to survive water-deprived circumstances through metabolic arrest, resuming normal performance and a green appearance when rehydrated. Different resurrection species have attracted the attention of scientists and naturalists, including in the present era of climate-change exacerbated drought in many parts of the world. In a scientific context, resurrection plants promise to offer genetic substances for creating new crop varieties resistant to the increasingly arid conditions accompanying climate change worldwide. While resurrection plants have been subjects of scientific scrutiny, they have also invigorated the imaginations of folklorists, historians, chroniclers, poets, and other writers in English, US-American, and Australian literary traditions through the ages—from herbalist John Gerard writing in the late 1500s and early 1600s to ecopoet John Kinsella in the present.

Of course, the literary history that has been assembled is abbreviated, incomplete, and weighted toward works of poetry. Nevertheless, the multidisciplinary methodology—provisionally termed "resurrecting"—demonstrates the value of an approach to critical comparative plant studies informed by scientific principles, particularly the precision afforded by taxonomic names. This approach has aimed to open up an area of inquiry that could be pursued further in subsequent analyses. Listening to the lessons of resurrection plants is essential to reimagining an ethical and sustainable future for humans and other-than-humans in an ever more globalized world mired in innumerable environmental predicaments, from deforestation and biodiversity loss to water pollution and contaminated soils. To this end, "resurrection" provides both a powerful metaphor and forceful ecological actuality underscoring the potential for beings and societies to come back to life, to be re-inspired, to find the appropriate means for creatively adapting to the dire circumstances at hand.

Toward a conclusion, the works collectively indicate a shared enthrallment with the plants' seemingly miraculous ability to return from states of near-death, as visually signified by the withering and browning of foliage. Whereas a poet like Moore highlighted the Christian resonances of resurrection in her observation of a Texas tumbleweed, contemporary figures like Kinsella and Ross reflect more ostensibly on the ecological significance of these species. On the one hand, early commentators were concerned with faithfully describing the unusual plant taxa that appeared to flout the conventions of biology; on the other, contemporary writers reveal concern for the continuation of resurrection plants in the native habitats. The latter group of writers suggest that an ethics of care will ensure the ongoing capacity of resurrection plants to perform their ancient cycles of dying then returning to life, and to inspire the human imagination for centuries to come.

Works Cited

- Black, Michael and H.W. Pritchard. "Glossary." *Desiccation and Survival in Plants: Drying Without Dying*. Eds. Michael Black and H.W. Pritchard. Wallingford: CABI Publishing, 2002. 373–82.
- Boughman, Arvis Locklear and Loretta Oxendine. *Herbal Remedies of the Lumbee Indians*. Jefferson: McFarland & Company Publishers, 2003.
- Buell, Lawrence. *The Environmental Imagination: Thoreau, Nature Writing, and the Formation of American Culture*. Cambridge: The Belknap Press of Harvard UP, 1995.
- Carrington, A., ed. *The Latter-day Saints' Millennial Star: Volume 30*. London: Latter-Day Saints' Book Depot, 1868.
- Dahlstrom, Michael. "Using Narratives and Storytelling to Communicate Science with Nonexpert Audiences." *PNAS: Proceedings of the National Academy of Sciences of the United States of America* 111 (2014): 13614–20.
- Dickinson, Alice. *Carl Linnaeus*. New York: F. Watts, 1967.
- Dimmitt, Mark. "Plant Ecology of the Sonoran Desert Region." *A Natural History of the Sonoran Desert*. Eds. Steven Phillips and Patricia Wentworth Comus. Tucson: Arizona-Sonora Desert Museum Press, 2000. 129–51.
- Duvall, Chris. *Cannabis*. London: Reaktion Books, 2014.
- Farrant, Jill and John Moore. "Programming Desiccation-Tolerance: From Plants to Seeds to Resurrection Plants." *Current Opinion in Plant Biology* 14 (2011): 340–45. <<http://dx.doi.org/10.1016/j.pbi.2011.03.018>>.
- Gaff, D.F. "Desiccation-Tolerant Flowering Plants in Southern Africa." *Science* 174.4013 (1971): 1033–34.
- Garrard, Greg. *Ecocriticism*. London: Routledge, 2004.
- Gerard, John. *The Herball, or, Generall Historie of Plantes*. London: Adam Norton and Richard Whitakers, 1636.
- Harper, Douglas. "Resurrection (n.)." *Online Etymology Dictionary* (2016): <<http://www.etymonline.com/index.php?term=resurrection>>.
- Harris, Stephen. *Grasses*. London: Reaktion Books, 2014.
- Harland, Gail. *Snowdrop*. London: Reaktion Books, 2016.
- Herrick, Robert. "To the Duke of York." *Bartleby.com* (2016): <<http://www.bartleby.com/337/392.html>>.
- Hetherington, Suzan and Robert Smillie. "Tolerance of *Borya nitida*, a Poikilohydrous Angiosperm, to Heat, Cold and High-light Stress in the Hydrated State." *Planta* 155.1 (1982): 76–81.
- Humphries, Simon. "Notes." *Christina Rossetti: Poems and Prose*. Ed. Simon Humphries. Oxford: Oxford UP, 2008. 401–95.
- King James Bible Online. "Ecclesiasticus 24:14." *King James Bible Online* (2016): <<http://www.kingjamesbibleonline.org/Ecclesiasticus-24-14/>>.
- Kinsella, John. *Armour*. London: Picador, 2011.
- Korte, N. and S. Porembski. "A Morpho-Anatomical Characterisation of *Myrothamnus moschatus* (Myrothamnaceae) Under the Aspect of Desiccation Tolerance." *Plant Biology* 14.3 (2012): 537–41.
- Lack, Andrew. *Poppy*. London: Reaktion Books, 2016.
- Lawson, Russell. *Frontier Naturalist: Jean Louis Berlandier and the Exploration of Northern Mexico and Texas*. Albuquerque: U of New Mexico P, 2012.
- Lucas, Susan. *Bamboo*. London: Reaktion Books, 2013.
- Marder, Michael. *Plant-Thinking: A Philosophy of Vegetal Life*. New York: Columbia UP, 2013.
- Marder, Michael. *The Philosopher's Plant: An Intellectual Herbarium*. New York: Columbia UP, 2014.
- McKee, Alan. *Textual Analysis: A Beginner's Guide*. London: SAGE Publications, 2003.
- Moore, Mollie. *Poems*. Houston: E.H. Cushing, 1872.
- Murray, Hugh. *The Encyclopædia of Geography Comprising a Complete Description of the Earth*. Philadelphia: Lea and Blanchard, 1843.
- Nakashima, Souichi, Hisashi Matsuda, Yoshimi Oda, Seikou Nakamura, Fengming Xu, and Masayuki Yoshikawa. "Melanogenesis Inhibitors from the Desert Plant *Anastatica hierochuntica* in B16 Melanoma Cells." *Bioorganic & Medicinal Chemistry* 18.6 (2010): 2337–45, <<http://dx.doi.org/10.1016/j.bmc.2010.01.046>>.
- Nikulinsky, Philippa and Stephen Hopper. *Life on the Rocks: The Art of Survival*. Fremantle: Fremantle Press, 2008.
- Pampurova, Suzana and Patrick Van Dijck. "The Desiccation Tolerant Secrets of *Selaginella lepidophylla*: What We Have Learned So Far?" *Plant Physiology and Biochemistry* 80 (2014): 285–90. <<http://dx.doi.org/10.1016/j.plaphy.2014.04.015>>.
- Pessin, Louis. "An Ecological Study of the Polypody Fern Polypodium Polypodioides as an Epiphyte in Mississippi." *Ecology* 6.1 (1925): 17–38.
- Phillips, Jonathan, Melvin Oliver, and Dorothea Bartels. "Molecular Genetics of Desiccation and Tolerant Systems." *Desiccation and Survival in Plants: Drying Without Dying*. Eds. Michael Black and H.W. Pritchard. Wallingford: CABI Publishing, 2002. 320–41.
- Romero, Mary. "Resurrection Fern." *Southwestern American Literature* 35.2 (2010): 76–7.
- Ross, Laura Sobott. "He Brings Me Resurrection Ferns." *Deep South Magazine* (2012): <<http://deepsouthmag.com/2012/02/14/he-brings-me-resurrection-ferns/>>.
- Rossetti, Christina. *Christina Rossetti: Poems and Prose*. Ed. Simon Humphries. Oxford: Oxford UP, 2008.
- The Society for the Diffusion of Useful Knowledge. *The Penny Cyclopaedia: Volume XIII, Intestines to Limoges*. London: Charles Knight and Co., 1839.
- Ugent, Donald. "Medicine, Myths and Magic: The Folk Healers of a Mexican Market." *Economic Botany* 54.4 (2000): 427–38.
- Vieira, Patricia, Gagliano, Monica, and John Ryan. "Introduction." *The Green Thread: Dialogues with the Vegetal*

- World*. Eds. Patricia Vieira, Monica Gagliano, and John Ryan. Lanham: Lexington Books, 2015. ix–xxvii.
- Williams, Brett, Isaac Njaci, Lalehvasht Moghaddam, Hao Long, Martin Dickman, Xiuren Zhang, and Sagadevan Mundree. "Trehalose Accumulation Triggers Autophagy During Plant Desiccation." *PloS Genetics* 11.12 (2015): 1–17. <<http://dx.doi.org/10.1371/journal.pgen.1005705>>.
- Wilkinson, Clyde. *The Broadening Stream: The Life and Literary Career of Mollie E. Moore Davis*. Champaign: U of Illinois at Urbana-Champaign P, 1947.
- Winkelman, Michael. "Frequently Used Medicinal Plants in Baja California Norte." *Journal of Ethnopharmacology* 18 (1986): 109–31.

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